A $1 + 1'$ RESONANCE-ENHANCED MULTIPHOTON IONIZATION SCHEME FOR ROTATIONALLY STATE-SELECTIVE DETECTION OF FORMALDEHYDE VIA THE $\tilde{\mathrm{A}}\,^1\mathrm{A}_2 \leftarrow \tilde{\mathrm{X}}\,^1\mathrm{A}_1$ TRANSITION

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The formaldehyde molecule is an important model system for understanding dynamical processes in small polyatomic molecules. However, prior to this work, there have been no reports of a resonance-enhanced multiphoton ionization (REMPI) detection scheme for formaldehyde suitable for rovibrationally state-selective detection in molecular beam scattering experiments. Previously reported tunable REMPI schemes are either non-rotationally resolved, involve multiple resonant steps, or involve many-photon ionization steps. In the current work, we present a new $1 + 1'$ REMPI scheme for formaldehyde. The first photon is tunable and provides rotational resolution via the vibronically allowed $\tilde{\mathrm{A}}\,^1\mathrm{A}_2 \leftarrow \tilde{\mathrm{X}}\,^1\mathrm{A}_1$ transition. Molecules are then directly ionized from the $\tilde{\mathrm{A}}$ state by one photon of 157 nm. The results indicate that the ionization cross section from the 4^1 vibrational level of the $\tilde{\mathrm{A}}$ state is independent of the rotational level used as intermediate, to within experimental uncertainty. The $1 + 1'$ REMPI intensities are therefore directly proportional to the $\tilde{\mathrm{A}} \leftarrow \tilde{\mathrm{X}}$ absorption intensities and can be used for quantitative measurement of $\tilde{\mathrm{X}}$-state population distributions.